

ART. X. THE LAND AND FRESHWATER MOLLUSCA
OF NEWFOUNDLAND

BY S. T. BROOKS

(PLATES XII AND XIII)

Newfoundland was visited by the author during the summer of 1934 to obtain material for a further study of the early distribution of the molluscan species in North America. Collections in this area were sparse but the records contained below seem to be of sufficient value to warrant publication. Many of these are from specimens in the collections of the Carnegie Museum and the ones included from the records of other institutions are so designated.

I wish to acknowledge the kindness of the following individuals and institutions who have given me such great aid in this work: Dr. A. Avinoff and the Trustees of this museum who made the trip possible; Dr. F. C. Baker of the Museum of the University of Illinois for his study of the *Lymnaeidae*; Mr. Calvin Goodrich and Dr. Van der Schalie of the Museum of the University of Michigan for their identification of the *Naiades*; Mr. W. J. Clench for his designations of the *Physidae* and for the several records¹ from the Museum of Comparative Zoology; Dr. H. A. Pilsbry and Mr. E. G. Vanatta for their assistance and for the use of the many records² published by Mr. Vanatta, and to Dr. Paul Bartsch and Dr. Harald Rehder for their identification of the *Succineidae* and for the records³ from the United States National Museum. Paratypes of the species herein described have been deposited by Dr. Baker and myself with the following: United States National Museum; Museum of Comparative Zoology; Museum of the University of Michigan; Museum of the University of Illinois; the Academy of Natural Sciences of Philadelphia; and with Dr. S. S. Berry of California.

Newfoundland is the tenth largest island and within the last year or so it has reverted to its original status as a British Colony.⁴ Not

¹Indicated in text as M. C. Z.

²Indicated in text as A. N. S. P.

³Indicated in text as U. S. N. M.

⁴The first British Colony and the beginning of the present British Empire.

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CHART OF SPECIES SHOWING THEIR DISTRIBUTION

Species	Distribution			
	West	Central	East	
<i>Helicigona arbustorum</i>	×	Importation
<i>Helix hortensis</i>	×	..	×	
<i>Zonitoides arborea</i>	×	×	×	
<i>Hawaii minuscula</i> *.....	×	
<i>Striatura exigua</i> *.....	×	
“ <i>milium</i> *.....	×	
<i>Euconulus fulvus</i>	×	×	×	
<i>Retinella electrina</i>	×	×	×	
<i>Vitrina limpida</i>	×	
<i>Deroceras agrestis</i>	×	..	×	Importation?
“ <i>læve</i>	×	×	..	
<i>Gonyodiscus cronkhitei</i>	×	×	..	
“ “ <i>anthonyi</i>	×	
<i>Helicodiscus parallelus</i>	×	×	..	
<i>Punctum pygmæum minutissimum</i> *.....	×	..	×	
<i>Arion ater</i>	×	Importation
“ <i>hortensis</i>	×	..	×	“
“ <i>fasciatus</i>	×	“
<i>Succinea ovalis</i>	×	×	×	
“ <i>avara</i>	×	
“ <i>peoriensis</i> *.....	×	
“ <i>grœnlandica</i> *.....	×	
“ <i>verilli</i>	×	
<i>Pupilla muscorum</i>	×	
<i>Vertigo modesta</i>	×	
“ “ <i>parietalis</i>	×	
“ “ <i>castanea</i>	×	
“ <i>gouldi paradoxa</i> St.....	×	
“ <i>elatior</i>	×	
<i>Columella edentula</i>	×	
<i>Cochlicopa lubrica</i>	×	×	..	
<i>Vallonia albula</i>	×	
<i>Zoogenites harpa</i>	×	..	×	
<i>Planogyra asteriscus</i> *.....	×	
<i>Carychium exiguum</i> *.....	×	
<i>Stagnicola palustris</i>	×	
“ “ <i>papyracea</i> **.....	×	
“ “ <i>perpalustris</i> **.....	..	×	..	
“ <i>newfoundlandensis</i> **.....	×	
<i>Fossaria obrussa</i> *.....	×	
“ “ <i>brooksi</i> **.....	×	
“ <i>umbilicata</i> *.....	×	
<i>Radix pereger geisericola</i>	×	
<i>Gyraulus parvus</i>	×	
“ <i>hornensis</i> *.....	×	
<i>Helisoma companulata davisii</i> *.....	×	
“ “ <i>minor</i> *.....	..	×	..	
<i>Physa gyrina</i>	×	
“ <i>heterostropha</i>	×	×	..	
<i>Valvata lewisii</i>	×	
<i>Valvata sincera nylanderi</i> *.....	×	
<i>Amnicola limosa porata</i> *?.....	..	×	×	
<i>Margaritana margaritifera</i>	×	×	×	
<i>Anodonta marginata</i>	×	..	×	
“ <i>implicata</i> *.....	×	

*new records.

**new to science.

that this political change has affected the molluscan kingdom, but at the present time a greater interest is manifest in Newfoundland about its animal and plant life than ever before. A friendly cooperation will meet the collector upon the island whether he is in search of plants, insects, or just plain "wrinkles" (snails) and "pussels" (mussels).

Two months were spent in traversing this region and the three major areas with their collections are indicated upon the accompanying chart. As shown here the greatest number of forms are western in distribution. This is in the region of which parts were untouched by the ice of the later Pleistocene Period. However, as it will undoubtedly be proven that the western portion does have the greatest number of native species, it is also necessary to point out that the present disparity is due mainly to the greater number of collections having been made on the west coast. It is necessary that more work be done around and west of Shoal Harbor, on the east coast, in order that the present distribution be properly known. At the present writing it seems that, since the Pleistocene, the dispersal of forms in Newfoundland has been generally eastward but a final picture of this phenomenon must await more collections in the eastern, southern, and central areas.

Not surprising, but quite instructive, was the finding that the great group of land snails have, through this long period of isolation, shown such a basic genetic strength in that they have retained specifically the features of their kind now living in northern Asia, Europe, and America. In no case are there any differences strikingly separating them from their other northern relatives. This lack of change is perhaps due to the similarity of the climate and vegetation of Newfoundland to that of the mainland. On the other hand, this long period of isolation has caused a greater change among the plants of the island. Many differing from those of the mainland clothe the hills and valleys and point to a long period of differentiation since, as well as prior to, the last glaciation. This paper, then, is not so much a statement of new facts as a restatement of facts and assumptions derived from earlier studies of the northern faunal areas of the earth. It is, however, as complete a resumé of the present knowledge of the molluscan fauna of Newfoundland as it is possible to make on the basis of the scanty collections.

DISCUSSION OF DISTRIBUTION OF THE FAUNA

A discussion of distribution, even in its most recent phases, is ever fraught with danger, and necessitates a certain form of mental gymnastics and credence well flavored with doubt. In the first place we know from other studies that there are certain circumpolar species which have been distributed to the three continents through what we might call the northern door; a sort of circumpolar "Garden of Eden" (Plate XIII). A study of these species will bring up in our imaginations a picture that shows a former continuity of the land masses. By means of this picture we can easily see how the various forms were dispersed and how through their migrations they advanced into each land, bounded only by the various ecological conditions governing their existence. Some were hardy and there were few limits to their movements, others were slower and more sensitive and more hedged in by their environment.

After these ancient lands had become populated, a series of vacillations occurred and the contiguous masses were separated. Newfoundland, which had formerly been a part of the ancient land including the maritime provinces of Canada and New England, was separated from the mainland during the late pleistocene and the Straits of Belle Isle were formed. This stretch of water was an effective barrier to any further dispersal of molluscan land life and probably was, later, an effective barrier to the glaciers. Even during the greatest glaciation it is probable that the island was not completely covered.⁵ Cer-

⁵Recently, in letters to the author, Dr. Carl O. Dunbar, Curator of Invertebrate Paleontology in the Peabody Museum, Yale University, and an authority on the glacial history of Newfoundland, has proven beyond doubt that the Long Range was, at one time during the Pleistocene, completely glaciated. Fernald believes that, amid the ice and snow, there were islands which gave shelter to the present flora. To me it is obvious that the present distribution of the land snails indicates that they did live through the vicissitudes of glaciation and the climatic changes existing after the separation of Newfoundland from the mainland. A complete glaciation of the entire island of Newfoundland, after its separation from the mainland, is precluded by the presence of the many species necessarily spread by a migration from the mainland. No human agency, no flight of birds, no importation of food-stuffs by the Red Indians or Beothucks, could explain the present population of the land snails, many of which are so minute as to escape notice by any but the specialist studying them. From my standpoint it is then necessary to explain the evidence as follows. *Following the complete glaciation of Newfoundland and the probable destruction of the fauna of that region, the warm interglacial*

tain peaks, certain areas, rose above the ice and formed habitable "glacial islands" upon which the plants and animals were enabled to exist through this hazardous period. These islands are indicated by the presence of a great number of plants (Fernald, M. L. *cf* Bibliography), and the present day, endemic molluscan fauna. With the dissipation of the ice the animals and plants again populated the surrounding areas and the present distribution is the result.

It is much too early in the study, or one might better say, in the collection of the Newfoundland fauna, to indicate whether or not any area outside of that of the Long Range was unglaciated. At first glance the accompanying chart suggests an eastern concentration of species. Disregarding the ones introduced through commerce, we have only one species of land snail which is not found either in the central or in the western portion of the island. The relatively few collections enable this to be explained as merely an oversight. So, from the study of the land shells, there is no reason to believe otherwise than that the natural dispersal of forms following the recession of the ice accounts for the present distribution. The very large number of species occurring on the west coast not only indicates their parent region but indicates also the greater number of collecting stations. The eastern part of Newfoundland has been only sparsely collected.

The water forms included here have a much more doubtful history. I believe that the majority of the forms listed are the relicts of an earlier distribution, probably contemporaneous with the land snails. This seems to be easily acceptable in view of the present distribution of *Margaritana margaritifera*, *Stagnicola palustris* and varieties, *Fossaria obrussa* and forms, the doubtful (in distribution) *Radix pereger geiseri-*

period allowed a re-population of Newfoundland from the mainland. The formation and flooding of the Bay of St. Lawrence followed, isolating the fauna and flora of this new island. Subsequent glaciations were local and sporadic, allowing refuge for the hardy northern species. I believe that this explanation, weak though it is, will be upheld by future studies of the marl deposits and other subfossil-bearing beds of Newfoundland. If not, and if the glacial studies carried on by Dr. Dunbar and his colleagues still conspire to wipe out the fauna and flora by a complete glaciation after the formation of the Bay of St. Lawrence, it will truly seem that the fauna of Newfoundland has found some means of dispersal yet unknown to the "distributionalist," and yet to be illuminated through observation and research. If, however, the land snails did come to Newfoundland through outside agencies, it was comparatively simple for them to attain their present distribution throughout Newfoundland during the many thousands of years that have followed.

cola, and the members of *Gyraulus*, *Physa*, *Valvata*, and *Amnicola*. They are, in other words, a parcel of the general distribution populating the early North American continent. With my sparse collections no more explicit explanation may be made. It is, however, extremely doubtful that any distribution of water forms into Newfoundland, since the ice age, has occurred. In the event of such an invasion, the entire island would necessarily have been surrounded with fresh water as the majority of the streams bearing these forms empty along the northern coast and are shut off from the mainland by the extensive northern peninsula.

LIST OF SPECIES

Family HELICIDÆ

Helix hortensis Müller

This common species so exhaustively treated in the past is, as one can see from the following list of localities, found mainly on the west coast of Newfoundland. In the Carnegie Museum it is also represented by specimens from Terra Nova (collected by Mrs. G. H. Durgin in the George H. Clapp collection) and from Shoal Harbor, both localities on the east coast. From questioning fellow travelers on the train I found that it was the common form to be found in their gardens (also eastern). From my collections it seems that this species will be found to be distributed generally across the northern portion of the island, although there is a very slight possibility that the collections at Shoal Harbor may point to an area which the glaciation left unharmed and which is thus supporting its own relict fauna. The locality at which I made the collection at Shoal Harbor is between six and eight miles inland from the town, on the slopes of a hill surrounded by spruce forests, dense undergrowth of alders, etc., and acres of boggy land. There is no possibility of this colony having been planted either intentionally or accidentally due to its inaccessibility. It is also peculiar that none of the townspeople, except my guide, Mr. Leslie Tuck, had seen one of these shells in the vicinity. I found them only after several discouraging days when Mr. Tuck finally remembered having seen "shells" at that place several years previous.

The specimens at hand, with one exception, are banded. The Shoal Harbor ones are typically banded and dark; the ones from Lomond, Bonne Pay, show nearly a complete coalescence of the bands

(123) (45), as do those from Gros Morne Mountain, Long Range, Bonne Bay. In the latter the bands 4 and 5 are separate but may or may not be joined at the aperture. The one specimen labelled "Bay of Islands" has distinct bands but shows the same tendency toward fusion. Three of the shells from Terra Nova are bandless while four have the formula (12345) and one the formula ${}_1(1234)_5$.

Some specimens received only recently from Dr. Carl O. Dunbar, Curator of Invertebrate Paleontology, Peabody Museum of Natural History, Yale University, show the following characteristics: three specimens from the mouth of Romaine Brook, 2 miles east of Port au Port, are all typically banded; 12345. Four specimens from the dune sand between Port Saunders and Pointe Riche differ from the others; one is bandless and exhibits the typical canary yellow color while the others are respectively 12345, (123) (45), and (12)3(45).

From my own findings and the findings of others there seems to be no reason to believe that this species came to Newfoundland and eastern America through any agency of man. They have, like the majority of forms taken up here, come into these regions through the natural growth of a species out from its center of origin. In this case, due to the destruction of the ancient distributional channels, we must accept Europe as the center of their dispersal. In view of the scanty area occupied in North America I feel that here we have the outer distributional fringe, or "dispersal fringe," demarked by their presence. *Helix hortensis*, in contrast with the more hardy *Cochlicopa lubrica*, is an example of the slow and more sensitive migrant. The distribution of this species in North America readily shows that it is hampered in its progress by temperature. The rigorous winters of our inland regions prevent it from spreading very far from the tempered climate of the sea coast. I would not say that this is the only barrier to this group, but it seems the obvious one in view of the fact of the greater dispersal of other circumboreal forms. This condition has been indicated in the writings of C. W. Johnson (1906), O. O. Nylander (1908), W. W. Winkley (1904), and others. Attempts to start colonies of this species in the comparative mildness of the Pittsburgh (Pennsylvania) region by Dr. George H. Clapp and the author have all ended in failure. Dr. Clapp believes that rodents are the main cause of their disappearance although I have been successful in keeping a colony alive and fairly intact without protection *until cold weather*. You will perhaps think of the cold winters of Newfoundland and the

St. Lawrence valley. It is true that the populated areas have cold winters, but it is also true that early and deep snowfalls blanket the hills and valleys until the mild days of spring thus protecting the animals from extremes of temperature. In our region (Pittsburgh) very little snow falls to protect them from the frequent freezes.

Western Stations: Bonne Bay; Tuckers Head, Lord and Lady Cove, Killdevil Mountain, Main Arm, Southern Arm, Deer Arm, Beach at Lomond, Gros Morne Mountain, (A. N. S. P. and C. M.). Bay of Islands; Hannah's Head, French Island, Lark Island, "Bay of Islands." Straits of Belle Isle; Doctor Hill, Bard Harbor Hill, Highland of St. John, St. John's Bay (A. N. S. P.). West Coast and south; Robinson's River, Serpentine River, Little Codroy and Great Codroy Valley, East River, Hawkes Bay, Ingornachoix Bay at Pointe Riche (A. N. S. P. and C. M.), Lewis Hills near Port au Port (M. C. Z.).

Eastern Stations: Shoal Harbor, Terra Nova (C. M.).

Helicigona arbustorum (Linnaeus)

This species was reported by J. F. Whiteaves (1863) from St. Johns. The specimens were found on the "grassy slopes facing the sea, near the narrows of St. Johns' Harbor" by Robert Bell in July, 1885. I was over this area in June, 1934, but found nothing. As indicated in the note this is probably an introduced form as it was found near the scene of several wrecks. A patch of heather is nearby and it is thought that this was from the discarded stuffing of bedding brought by the immigrants; they discarded the bedding when it became spoiled from moisture during their escape from their wrecked vessel.

Family ZONITIDÆ

Zonitoides arborea (Say)

This species, common to Asia and America, has a wide distribution on this island, occurring from the eastern coast to the Long Range and north to the very tip of the peninsula. Its wide distribution in North America is well known and from its appearance in Newfoundland it seems to have populated this area at an early date. Although it is a common form it is never collected in great numbers. At Grand Falls it occurred with *Cochlicopa lubrica* under damp logs near pools along a wood road. Back from the river it was not found, due, perhaps, to

the acid bogs although the "flies" made the search for it in these sheltered places a veritable nightmare.

Western Stations: Bonne Bay; Gros Morne Mountain, Beechy Point, Stanleyville, Lomond. Bay of Islands; Hannah's Head. Straits of Belle Isle; Bard Harbor Hill, Doctor Hill, Burnt Cape at Pistolet Bay, Pointe Riche. (A. N. S. P. and C. M.).

Central Stations: Banks of the Exploits River at Grand Falls (C. M.)

Eastern Stations: Shoal Harbor (C. M.).

Hawaii minuscula (Binney)

A new record for Newfoundland and a common circumpolar species of Asia and America. This species was found in the siftings of forest loam from Lomond, Bonne Bay, west coast.

Striatura exigua (Stimpson)

This species was collected at Lumber Camp No. 31, near Lomond, and at Gros Morne Mountain, Bonne Bay. It is new to the fauna of this island but in America it is found from Maine and Quebec west to the Rocky Mountains.

Striatura milium (Morse)

A new record for Newfoundland and collected at Shoal Harbor on the eastern coast.

Euconulus fulvus (Müller)

This species, common to three continents, is wide spread in its distribution in Newfoundland.

Western Stations: Bonne Bay; Tucker's Head. Bay of Islands; Hannah's Head. Straits of Belle Isle; Cape Norman, Savage Cove, Ha Ha Cape, Bard Harbor Hill, Doctor Hill, Schooner Island, Anse aux Sauvages (A. N. S. P.).

Central Stations: Red Indian Lake and Banks of the Exploits River, Grand Falls (C. M.).

Eastern Stations: Shoal Harbor (C. M.).

Retinella electrina (Gould)

This typically American species is found from the eastern coast of Newfoundland to Alaska.

Western Stations: Bonne Bay; Tucker's Head, Lomond. Bay of Islands; French Island, Middle Arm, Hannah's Head. West coast and north; Brig Bay, Schooner Island, Anse aux Sauvages, Cape Norman, Ha Ha Cape, Bard Harbor Hill, Penguin Head (A. N. S. P. and C. M.).

Central Stations: Banks of Exploits River, Grand Falls (C. M.).

Eastern Stations: Shoal Harbor (C. M.).

Vitrina limpida Gould

So far, this species has been found only on the west coast (A. N. S. P.) near Pointe Riche. In America it is a species confined to the northeastern area. Its most southern range is along the Ohio River in Allegheny County, Pennsylvania. It had been distributed by floods originating in western New York state where it is a fairly common species.

Family LIMACIDÆ

Deroceras agrestis (Linnæus)

The consensus of opinion would place this species among those of the introduced forms. However, in Newfoundland it has been collected from two widely separated localities; Bard Harbor Hill and Doctor Hill (A. N. S. P.) on the west coast and on the banks of Manuels River at Manuels, near St. Johns (C. M.).

Deroceras læve (Müller)

This species differs from the above in being an endemic form. It occurs in both Europe and America and in central and western Newfoundland. It is undoubtedly a species of the "original distribution." More collections will greatly extend its range on this island.

Western Stations: Mauve Bay near Cape Bauld, Lark Harbor, Savage Cove, Ha Ha Cape, Yankee Point, Flower's Cove, Doctor Hill (A. N. S. P.).

Central Stations: Banks of the Exploits River, Grand Falls (C. M.).

Family ENDODONTIDÆ

Helicodiscus parallelus (Say)

This species is distributed over the entire eastern United States and southern Canada. In Newfoundland, it has been found on the west coast at Hannah's Head (A. N. S. P.), Lomond (C. M.), and in the central area at Grand Falls on the banks of the Exploits River (C. M.).

Punctum pygmæum minutissimum (Lea)

In the United States, this species has a range from Maine south to Virginia and west to Arizona. In Newfoundland, it has been collected at Tucker's Head, Hannah's Head, Bard Harbor Hill on the west coast (A. N. S. P.) and from Shoal Harbor on the east (C. M.).

Gonyodiscus cronkhitei (Newcomb)

This form of western America is wide spread in Newfoundland. No records at hand show that it has been collected at any place between Newfoundland and the Rocky Mountains. In the collections of the A. N. S. P., it is listed from Tucker's Head, Hannah's Head, Anse aux Sauvages, Yankee Point, and in our collections from Beechy Point, Lomond, and Gros Morne Mountain on the west coast, at Grand Falls in the central region, and from Shoal Harbor on the eastern seaboard.

Gonyodiscus cronkhitei anthonyi (Pilsbry)

Although my collections contained none of this form it has been collected (A. N. S. P.) in the western part of the island; Bard Harbor Hill, Savage Cove, Brig Bay, Pointe Riche, Cape Norman, Ha Ha Cape, Grassy Island, St. John's Bay and Doctor Hill.

Family ARIONIDÆ

Arion ater (Linnæus)

Undoubtedly an introduced form, collected at Bay Bulls, east coast (A. N. S. P.). It has been found only twice before on the American Continent.

•
Arion hortensis Ferrusac

Another introduced species of a very localized distribution in America. Collected in the western part of Newfoundland at Beechy Point, near Lomond, Bonne Bay (C. M.), Lark Harbor, Bay of Islands (A. N. S. P.), and on the eastern side at Manuels on the banks of the Manuels River (C. M.).

Arion fasciatus Nils

Introduced: Reported from Trepassy and Whitbourne (A. N. S. P.), both in the eastern part of the island.

Family SUCCINEIDÆ

Succinea ovalis Say

Western Stations: Lark Harbor, Savage Cove, Flower's Cove, Eddies Cove, St. John's Island, Bard Harbor Hill, Doctor Hill. Bonne Bay; Tucker's Head (A. N. S. P.), Lomond, Camp 31, Stanleyville, Beechy Point, Gros Morne Mountain, "Bay of Islands" (C. M.). Deer Lake, Nicholsville, Hawkes Bay (M. C. Z.). Baleana Bay (No. 180190 U. S. N. M.).

Central Stations: Banks of the Exploits River at Grand Falls (C. M.).

Eastern Stations: Shoal Harbor and Terra Nova (C. M.).

Succinea avara Say

Western Stations: Sandy Cove (Bay?), Cape Norman, Yankee Point, Four Mile Cove, Big Brook, St. John's Island, Flower's Cove, Savage Cove, Savage Point, Pointe Riche, Brig Bay. Bonne Bay; Tucker's Head (A. N. S. P.), Lomond (C. M.).

Succinea verrilli Bland

Anchor Cove, Flower's Cove, Bard Harbor Hill, St. John's Island, Old Port au Choix, St. John's Bay, Main River (A. N. S. P.), all west coast.

Succinea grœnlandica (Beck) Möller

A surprising species to find and a new record for Newfoundland. Collected at Lomond, Bonne Bay (C. M.).

Succinea peoriensis "Wolf" Walker

Another new record from Lomond Depot, Camp 31, and Stanleyville, all on western coast (C. M.). Dr. Rehder says that these are not all typical of the species and somewhat "similar to *S. peoriensis fulltonensis* F. C. Baker."

Family PUPILLIDÆ

Pupilla muscorum (Linnæus)

Western Stations: Bonne Bay; Tucker's Head. Straits of Belle Isle and north; Doctor Hill, Pointe Riche, Ha Ha Cape, Ha Ha Bay, Cape Norman, Anse aux Sauvages (A. N. S. P.).

Vertigo modesta (Say)

Western Stations: Tucker's Head, Pointe Riche, Anse aux Sauvages, Great (?) Sacred Island, Savage Cove, "Sandy Cove = Poverty Cove" = Sandy Bay?, Bard Harbor Hill, Doctor Hill, Flower's Cove, Ha Ha Cape, Brig Bay, Yankee Point, Savage Point; there are two by this name, this may be the more northern one in Cremaillere Harbor and not the Savage Point at Great Goose Harbor (A. N. S. P.).

Vertigo modesta parietalis Ancey

Western Stations: Anse aux Sauvages, Great Sacred Island, Ha Ha Cape (A. N. S. P.).

Vertigo modesta castanea Sterki

Western Stations: Schooner Island, Pistolet Bay, Cape Norman, Flower's Cove (A. N. S. P.).

Vertigo gouldi paradoxa Sterki

Western Stations: Bonne Bay; Tucker's Head. Bay of Islands; Hannah's Head. Straits of Belle Isle; Ha Ha Cape, Bard Harbor Hill (A. N. S. P.).

Mr. Vanatta writes that *V. coloradensis* and *V. coloradensis basidens* are now considered as the above species.

Vertigo elatior Sterki

Schooner Island (A. N. S. P.) and Lomond, Bonne Bay (C. M.), both on the west coast.

Columella edentula (Draparnaud)

Western Stations: Anse aux Sauvages, Sacred Island, Schooner Island, Savage Point, Yankee Point, Ha Ha Cape, Doctor Hill, Bonne Bay; Tucker's Head (A. N. S. P.).

Family COCHLICOPIDÆ

Cochlicopa lubrica (Müller)

This species is probably the most common of any of the shelled snails in Newfoundland. It is surprising not to find it in the eastern part of the island. The absence of the species at Shoal Harbor is probably due entirely to oversight.

Western Stations: Bonne Bay; Beechy Point, Stanleyville, Lomond (C. M.), Tucker's Head. Bay of Islands; Hannah's Head, Tweed Island, Penguin Island (Bay of Islands?). Straits of Belle Isle; Schooner Island, Ha Ha Cape, Eddies Cove, Eddies Cove Brook, Bard Harbor Hill, Doctor Hill (A. N. S. P.).

Central Stations: Banks of the Exploits River, Grand Falls (C. M.).

Family VALLONIIDÆ

Vallonia albula Sterki

From the records of the A. N. S. P.; Tucker's Head in Bonne Bay, Penguin Head, and at Pointe Riche on the northwestern coast.

Zoogenites harpa Morse

From the records of the A. N. S. P.; Ship Cove, Sacred Bay, Anse aux Sauvages, Deer Pond Brook in Bard Harbor, and collected by me at Shoal Harbor.

Planogyra asteriscus Morse

A new record for this species; collected at Lomond (C. M.).

Family CARYCHIIDÆ

Carychium exiguum (Say)

A new record from Lomond (C. M.).

THE AQUATIC GASTROPODA

Family LYMNÆIDÆ

Stagnicola palustris (Müller)

The following collections from the records of the A. N. S. P. may be found to agree* with one of the varieties described by Dr. Baker (1935). Until this has been determined I shall list the localities separately.

Western Stations: Straits of Belle Isle; Cook's Point, Pistolet Bay, Schooner Island, Sandy Cove, Flower's Cove, Otter Pond near Plumb Point, Brig Bay, Eddies Cove, Boat Harbor, Big Brook, Savage Point, St. John's Island and Bay of St. John.

Stagnicola palustris papyracea Baker and Brooks

This new variety was collected in Rocky Pond, near Whitbourne. The descriptions as published in *The Nautilus* (1935) will be repeated here for convenience sake.

"Shell differing from *S. p. ungava* F. C. Baker in being more ovate with spire and aperture about equal in length, the whorls of the spire not as high as those of *ungava*, the sutures less deeply indented; inner lip narrow, the columellar plait quite distinct and the umbilical chink small or absent; color light horn, interior of aperture light or dark chocolate color; sculpture of finer lines than in *ungava*. All apices are decollate and but four whorls remain, but there are apparently six whorls in mature examples.

Length	18.6	diam.	10.5	aper. length	10.5	width	5.7 mm.	Holotype
"	18.1	"	10.0	"	10.5	"	5.7 "	Paratype
"	17.1	"	9.9	"	9.5	"	5.1 "	"

This race of *palustris* at once suggests *S. p. ungava*, differing in the shorter spire, narrower inner lip and distinct columellar plait. It differs from *S. p. elodes* in its shorter, less acute and obese body whorl. The shells are very thin which suggests the varietal name. The race is very constant in form and does not appear to vary to any extent toward typical *palustris* or its known varieties."

*Mr. Vanatta writes: "Could call all *Lymnaea palustris* from Newfoundland, var. *newfoundlandensis* B. and B."

Stagnicola palustris perpalustris Baker and Brooks

A new variety found inhabiting the pools along the Exploits River at Grand Falls.

"Shell obese, with large ovate aperture and short, dome-shaped spire, the latter shorter than the aperture; sutures well impressed; outer lip thin with only a slight variceal thickening within the edge; inner lip rather broad, appressed tightly to the columella leaving only a slight umbilical chink; columella plait heavy, parietal wall with distinct callus; color dark horn, interior of aperture dark chocolate colored; sculpture of heavy growth lines and impressed spiral lines; surface often malleated; only four whorls visible in mature shells, all spires decollated. Young shells indicate that there are probably six whorls in fully matured shells.

Length	19.1	diam.	11.3	aper. length	12.0	width	6.6 mm.	Holotype
"	17.6	"	10.4	"	11.1	"	6.0 "	Paratype
"	17.1	"	10.5	"	10.5	"	5.8 "	"

This race of *palustris* is at once recognized by its broad form, depressed spire and large aperture. It does not closely resemble any of the described forms of this protean species, approaching most closely to some short spired forms of *S. p. nuttaliana* from the Rocky Mountain area."

Stagnicola newfoundlandensis Baker and Brooks

This species inhabited the "steady" near camp 31, eight miles from Lomond, Bonne Bay.

"Shell elongated with acute somewhat turreted spire as long as or longer than the aperture; spire whorls rounded with well impressed sutures; body whorl well rounded; aperture ovate, outer lip thin, inner lip flattened and reflected over the umbilical region leaving a small chink; the callus on the parietal wall is thin or absent; columellar plait absent or but slightly developed; color dark horn, aperture coffee colored within; sculpture of coarse growth lines and well developed spiral lines; there are six whorls.

Length	20.0	diam.	9.9	aper. length	10.0	width	5.3 mm.	Holotype
"	22.0	"	10.0	"	10.0	"	5.1 "	Paratype
"	18.8	"	9.2	"	9.0	"	4.7 "	"
"	17.0	"	9.0	"	9.2	"	5.1 "	"

This lymnæid resembles some of the elongate forms of the *Stagnicola emarginata* complex, especially *canadensis* and *ontariensis*. The color of the shell and aperture are different from *canadensis* and the inner lip is not turned back to form so flat a projection over

the umbilical region. Compared with specimens of *ontariensis* from the St. Lawrence River below Quebec the shell is more elongated with longer, narrower, more acute spire, the inner lip is not flattened and the color is much darker. A few specimens of the new form resemble certain forms of *S. p. elodes* but the typical forms have a different and heavier sculpture, a more rounded body whorl, a more acute spire, and the columellar lip is wider at the lower part and lacks the heavy, twisted plait of typical *elodes*.

There is a great variation in the height of spire and width of shell but the greatest number of specimens are uniform and it seems best to recognize this form as a species distinct from either the *palustris* or *emarginata* complex."

Fossaria obrussa (Say)

This species was collected at the same locality as the above. The range of this form as given by Baker (1911) is "from the Atlantic to the Pacific Ocean and from Mackenzie Territory and Quebec south to Arizona and northern Mexico," so it is not surprising that this species is found in Newfoundland. However, this is the first time that this species has been recorded from there. It was collected on exposed sticks and stones and in the surface film covering deep muck of vegetable origin, near the "steady" below the "little pond." Within a short distance there was a large bed of *Margaritana margaritifera*, and in the shoal waters were the *Helisoma* and *Gyraulus* mentioned below. It was unusual to find areas supporting as many forms as did this one.

Fossaria obrussa brooksi F. C. Baker

The type locality for this form is the same as that of *newfoundlandensis*. These were collected from the surface of the mud around the swampy areas of the "steady." As near as I could determine the term "steady" applies to any enlarged, lake-like portion of the creek or river. This also happened to be one of the favorite "salmon holes" of the region.

"Shell differing from *Fossaria obrussa decampi* in having a longer, more acute and turreted spire, a shorter, more obese body whorl, a smaller, rounded aperture and a larger umbilicus; whorls shouldered; color light or dark horn, the aperture chocolate or coffee colored within; there are six whorls.

Length	11.5	diam.	6.0	aper. length	5.1	width	2.9 mm.	Holotype
"	9.1	"	4.7	"	"	4.6	"	2.2 "
"	8.4	"	4.0	"	"	3.8	"	2.0 "

This distinct little lymnæid is related to *obrussa*, approaching most nearly to the race *decampi*. Its long scalariform spire, short, rounded body whorl, and small rounded aperture, will at once distinguish it from *decampi*."

Fossaria umbilicata (C. B. Adams)

Baker's (1911) intimation that this form was an inhabitant of the more northern regions ("of the Canadian and Nova Scotian regions"), finds its proof in the discovery of this species in Newfoundland. It was collected along the logging road to Deer Lake not far from Lomond, Bonne Bay. It was found on damp sticks and stones in the marshy drainage of a roadside spring.

Radix pereger geisericola (Beck)

This species was reported from Junction Pond, Whitbourne, by Vanatta. My specimens came from Rocky Pond which is only a few minutes down the railroad tracks from the former locality. This species was originally described as living in "the hot waters of the geysers of Iceland (vide Mörch)", according to Baker (l.c.), and it is indeed a mystery how they came to the cold Newfoundland lakes.

Family PLANORBIDÆ

Gyraulus parvus (Say)

Vanatta lists this species as occurring on the west coast; near the Straits of Belle Isle, Otter Pond near Plumb Point, East Brook (? East River on my map), at St. Barbe Bay, and Eddies Cove Brook in Eddies Cove.

Gyraulus hornensis F. C. Baker

Collected in the "steady" near camp 31. This species has only recently been described from Canada, and as Dr. Baker says, "This is a long way from home but is certainly this species." I shall repeat the description as he gives it (1934).

"Shell depressed, the periphery rounded; color light corneous, surface shining; sculpture of fine oblique lines of growth and with very fine spiral lines, more or less conspicuous; nuclear whorls small, rounded, spirally striate in sculpture; whorls about four, rapidly en-

larging, the last somewhat expanded near the aperture, roundly angled at the periphery of the last whorl, the upper part of the body whorl slightly flattened; spire flat, the whorls coiled in the same plane; the body whorl may be nearly in line with the spiral turns or it may be deflected about a third of the distance from the aperture; sutures deeply channeled; base concave exhibiting all of the whorls, the umbilical region wide, but the body whorl well rounded, not flattened or having a reamed-out appearance; aperture obliquely, ovately rounded; lip thin, sharp, simple, or slightly thickened with a callus deposit; parietal wall with a wide callus."

Greatest height 2.0, greatest diameter 4.6 mm. Described from Birch Lake, Horn River, 75 miles above the Mackenzie River, Mackenzie District, Canada. Collected by E. J. Whittaker in 1921.

This species ranges from Wisconsin and North Dakota north to the type locality and east to Newfoundland.

***Helisoma campanulata davisii* (Winslow)**

Collected along the road near camp 31, Lomond, Bonne Bay. This species was described by Miss Minna Winslow (1926) from the Pinnebog River, Huron County, Michigan. This variety differs, according to Baker from *rudentis* (Dall) "in its smaller size, much less axial height, and particularly in the form of the umbilicus, which in *rudentis* is distinctly cone-shaped or funnel-shaped." This is the first record of this variety from so easterly a region. Is it a case of distribution by natural means or is it a convergent development due to the similarity of habitat and climate? The latter seems the most feasible.

***Helisoma campanulata minor* (Dunker)**

This form of *campanulata* was collected in Stony Brook, across the Exploits River at Grand Falls. It is figured and commented upon by Miss Winslow (l.c.), from Crooked Lake, Montmorency County, Michigan.

Family PHYSIDÆ

***Physa gyrina* Say**

Mr. Vanatta lists this from "Otter Pond, near Plumb Point" and from "Brig Bay," west coast.

***Physa heterostropha* Say**

In the collections of the Museum of Comparative Zoology from Nicholsville, Humber River, and in my collection from camp 31, Lomond, Bonne Bay, on the west coast. In the central area I collected it at Stony Brook, across the Exploits River from Grand Falls, and in pools along Rushy Pond Road at Grand Falls.

Family VALVATIDÆ

***Valvata lewisii* Currier**

Vanatta lists this from Eddies Cove Brook, west coast, and I collected it from the "steady," camp 31, Lomond, Bonne Bay.

***Valvata sincera nylanderi* Dall**

Collected by me in Rocky Pond, Whitbourne, in the eastern area.

Family AMNICOLIDÆ

***Amnicola limosa porata* Say**

Or near this species. Collected by me in Rocky Pond, Whitbourne, and in Stony Brook, across the Exploits River from Grand Falls.

THE FRESH WATER PELYCYPODA

***Margaritana margaritifera* (Linnæus)**

Southwest River, Belvoir Bay, in Hare Bay (C. M.). Southwest River (M. C. Z.), probably same locality; both southwestern. Dr. Bryant Walker (1910) records it from St. Barbe Island, Birchy Brook and Sandy Pond; probably western. Vanatta lists it from Junction Pond, Whitbourne; eastern, and I collected the same from "Chitman's Water," and Rocky Pond, Whitbourne; both probably of the same drainage, and from the Exploits River, Grand Falls; central. I also found it near camp 31, Lomond, Bonne Bay. Dr. Bartsch writes that they have two sets, Nos. 86292 and 86288, U. S. N. M., labelled "Newfoundland."

From the above stations we can see that this species is wide-spread over the island, occurring from the eastern portion at Whitbourne

west to Lomond. It will probably be found to be distributed over the entire island. Various Newfoundlanders, that I talked to, told me of taking "pussels" during the spring and boiling and eating them. I questioned them to determine whether these were the fresh water forms, and they assured me that they were. I presumed that they were speaking of this species; however, I marvelled at their gastronomic prowess.

***Anodonta marginata* Say**

Reported by Vanatta from Otter Pond near Plumb Point, and from Junction Pond, Whitbourne.

***Anodonta implicata* Say**

Collected by the son of Peter Pettipas for me at Whitbourne in "Well's Gully." This is the first record of this species from Newfoundland. Its presence here supports Whiteaves' findings (1863) in the St. Lawrence River, and Marshall's findings (1895) in the Ottawa River, both findings questioned by Ortmann in his catalogue.

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EXPLANATION OF PLATE XII

1. *Stagnicola newfoundlandensis* Baker and Brooks.
2. *Fossaria obrussa brooksi* F. C. Baker.
3. *Stagnicola palustris perpalustris* Baker and Brooks.
4. *Stagnicola palustris papyracea* Baker and Brooks.

Photographed on millimeter ruler.



